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Erratum: Axion like particles and the inverse seesaw mechanism

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The two models containing two ALPs in section 2.3 of ref. [1] lead to too light non-SM charged leptons E of only a few GeV. (The single ALP model of section 2.2 does not suffer from this problem.)

This problem can be amended without significant modifications by considering two heavy vector-like fermions E and E' instead of one. Instead of the last two terms of eq. (2.40), (2.41) and (2.47) of [1], we should consider the four terms

$$\begin{aligned} -\mathscr{L} \supset\, & k_i \frac{\sigma\sigma'}{M_{\rm Pl}^2}\overline{L_i} H E_R + k'_i \frac{\sigma\sigma'}{M_{\rm Pl}^2}\overline{L_i} H E'_R \\ & + k_E \sigma \overline{E_L} E_R + k'_E \sigma' \overline{E'_L} E'_R + \text{H.c.}\,, \end{aligned} \tag{1}$$

where we already fixed the r, r' powers without affecting any formula. One should use $s = s' = 1$ if needed. Now the heavy leptons E, E' have intermediate scale masses of order $10^{9\div 10}$GeV. The charge of the discrete symmetries are only modified for $E_{L,R}$ and $E'_{L,R}$ in a predictable manner; see table below. Appropriate normalization of these charges leads to the PQ charges X, X' and the extended lepton numbers L, L'. Note that $\mathrm{U}(1)_X$ [$\mathrm{U}(1)_{X'}$] is vectorial for E' (E) and that the first two terms of the Lagrangian above implies E_R and E'_R have equal charges (X, X', Z, Z', L, L'). The rest of the formulas and the phenomenological consequences remain unchanged.

Additionally, the lowest order operator coupling $\bar{L}$-S_R for model II is $\bar{L}\tilde{H} S_R \sigma^4 \sigma'$ instead of $\bar{L}\tilde{H} S_R \sigma^2 \sigma'^*$. This implies $m_{\rm DS}$ is negligible in eq. (2.52).

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	E_L	E_R	E'_L	E'_R
$\mathbb{Z}_8$	2	1	1	1
$\mathbb{Z}_{11}$	1	1	3	1

	E_L	E_R	E'_L	E'_R
$\mathbb{Z}_8$	3	2	2	2
$\mathbb{Z}_{10}$	-1	-1	1	-1

Table 1. Corrected charges for model I (left) and model II (right).

References

[1] C.D.R. Carvajal, A. G. Dias, C.C. Nishi and B.L. Sánchez-Vega, *Axion like particles and the inverse seesaw mechanism*, *JHEP* **05** (2015) 069 [arXiv:1503.03502] [INSPIRE].

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